Model PM-30MV Milling Machine

2 HP (1.5 kW) brushless dc motor, 220 Vac single phase power
Quiet belt drive, no gears
Variable spindle speed from 50 to 3000 rpm
Table size 33” x 8-1/4”
Quill DRO for precise downfeed measurement
Square column design, heavy cast iron construction
Options: Table (X-axis) power feed; 3-axis DRO;welded steel stand/cabinet
Machine weight 530 lb, stand 75 lb

PM-30MV with 3-axis DRO (option)

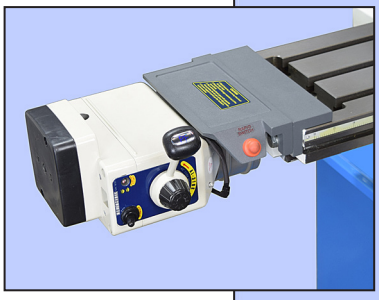


Table power feed (option)

PM-30MV on stand/cabinet (option)

Copyright © 2020 Quality Machine Tools, LLC

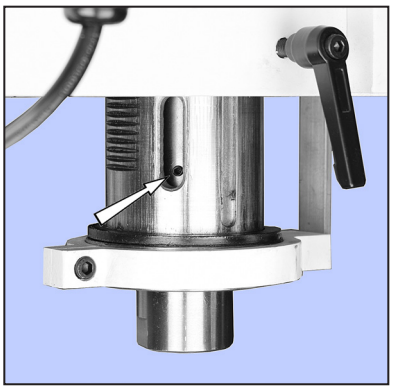
PM-30MV

FAQ

! My mill doesn't run

220 Vac power connected?
Fuse good? (left side of this box)
E-Stop button out? (pop it out by twisting firmly to the right.)
CHIP GUARD open? (close it)

! R8 collets won't go into the spindle



The collet locating screw could be in too far. Back it out a little.

This manual describes PM-30MV machines as shipped from June 2017. It contains essential safety advice on the proper setup, operation, maintenance, and service of the machine. Failure to read, understand and follow the manual may result in property damage or serious personal injury.

There are many alternative ways to install and use a mill. As the owner of the mill you are solely responsible for its proper installation and safe use. Consider the material contained in this manual to be advisory only. Quality Machine Tools, LLC cannot be held liable for injury or property damage during installation or use, or from negligence, improper training, machine modifications or misuse.

There may be detail differences between your specific machine and the information given here (with little or no impact on functionality). Please email us if you have questions about any aspect of the manual or your machine (see our website www.precisionmatthews.com for support addresses). Your feedback is welcomed!

Copyright © July 2017 Quality Machine Tools, LLC
No portion of this manual may be reproduced or distributed in any form without the written approval of Quality Machine Tools, LLC.

Section 1 INSTALLATION

THESE ARE THE MAIN POINTS TO WATCH OUT FOR!
But read the following pages for more information

- Handling the mill is at least a two-man job.
- Lower the center of gravity by hand-cranking the headstock down until the spindle nose is just clear of the table.
- Lifting gear – sling, hoist or forklift – must be rated for at least 1000 lb.
- Working location of the mill must allow: Full left-right travel of the table, and; Access to the top of the column (for Z-axis leadscrew maintenance).
- Power requirement is 220V, 60Hz, 15A minimum.
- Extension cord not recommended; if no alternative, use 12 AWG not longer than 20 ft.
- Before connecting power for the first time be sure that:
    1. The machine is on a firm footing, adequately secured to bench or stand.
    2. No chuck or collet is installed.
    3. There are no clamps or locks on moving parts.
    4. The speed control knob is set for the lowest speed.

Setting up the mill

The PM-30MV is shipped in two packing cases, one for the machine and tray (including optional 3-axis DRO), one for the stand, if ordered. The following procedure makes use of an ***engine hoist***, minimum weight rating 1000 lb.

The machine shown in the uncrating and installation photos, Figures 1-1, 1-2 and 1-3, is the PM 25-MVBD. This is smaller and lighter than the PM-30MV, but otherwise representative.

1. Prepare the working location, bench or optional stand. ***Highly recommended!*** Bolt the bench or stand firmly to the floor. Check working clearances, Section 2.
2. Remove the packing case from the pallet, Figure 1-1. Unbolt the machine from the pallet. Install the largest of the four handles on the headstock handwheel (top of column on right). Install the three smaller handles on the X-axis and Y-axis handwheels.
3. Release the Y and Z axis locks. Check that the mill's center of gravity is as far down and back as possible by cranking both Y and Z handwheels.
4. Pad the underside of the tilt collar with thick cloth.
5. Run a sling under the cloth padding, taking care not to damage the Z-axis locking handle and the cooling fins on the electrical box, Figure 1-2.
6. Hook the sling to the hoist. Slowly lift the mill, controlling any tendency for it to swing as it clears the pallet.
7. Roll the mill into position over the tray, then lower it into place, Figure 1-3.
8. Secure the mill to the bench or stand. If this is a stand installation, use the four bolts M12 bolts supplied (the bolt locations are threaded.) Use lock + plain washers in all locations.

Figure 1-1 **Mill ready for lifting**

 Copyright © 2020 Quality Machine Tools, LLC

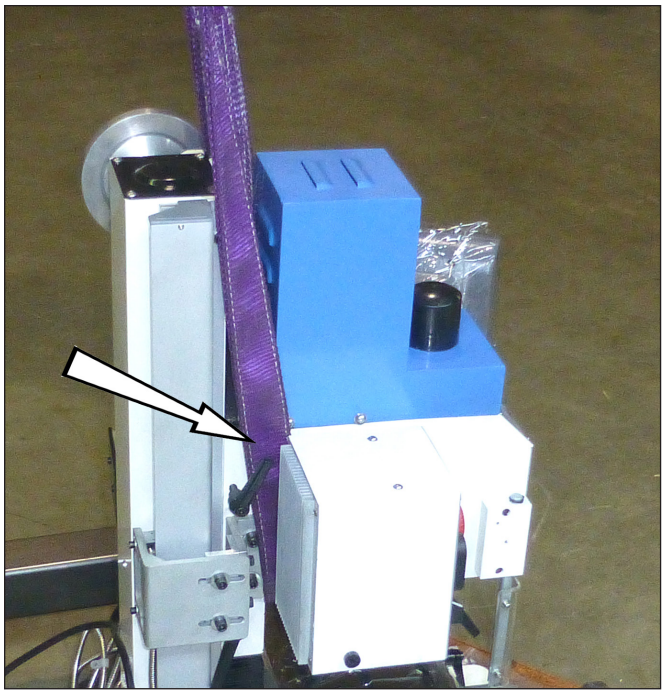


Figure 1-2 **Sling position**

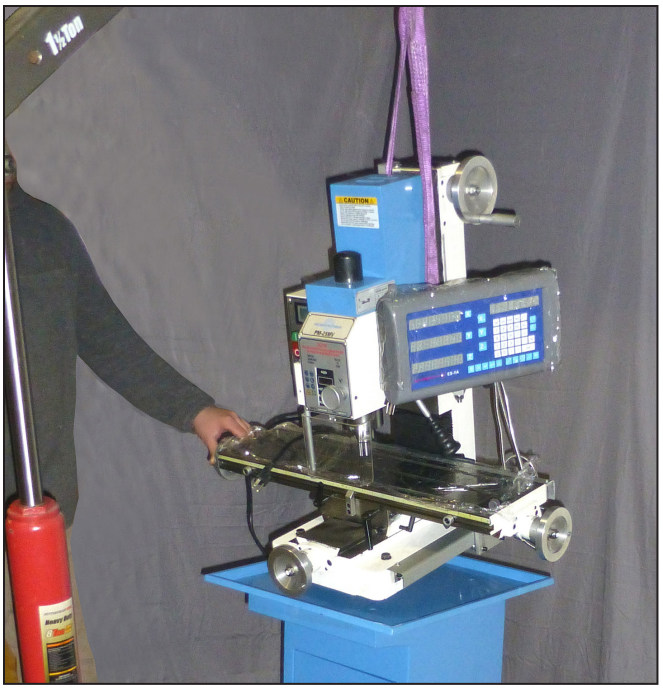


Figure 1-3 **Lowering the mill into position**

Assembly and cleanup

Unfinished metal surfaces may be protected in shipping by thick grease and/or paper. Carefully remove these using a plastic paint scraper, disposable rags and a light-oil such as WD-40. Coat bright machined surfaces with a rust preventative such as Rustlick.

Level the mill using the table surface for reference, shimming under the tray if necessary. Oil the ways and leadscrews (Z-axis screw excepted, inaccessible).

Initial checks

Read Section 3 if unsure about any item in the following

1. Check that: A There is no chuck or collet is installed; B There are no clamps or locks on moving parts, and; C The speed control knob is at its ***lowest setting***, fully counter-clockwise.
2. Remove the blue motor cover. Make sure the belt is set for low speed (belt running on the larger spindle pulley.) If not, re-position the belt, Figure 3-2. Replace the motor cover.
3. Connect 220 Vac power.
4. Be sure the E-Stop (Emergency) button has not been pushed in (it should pop out when twisted firmly clockwise).
5. Press the Power button. The power lamp and the tach display should light.
6. Check the emergency function by pressing the E-Stop button. The power lamp should go out, de-energizing the contactor circuit, disabling all electrics. ***If this doesn't happen, the E-stop function is defective, and needs attention.***
7. Restore power by twisting the E-Stop button ***firmly*** to the right; this will cause it to pop out.
8. Check that the chip guard switch disconnects power when the guard is swung out.

Test run procedure

DO NOT LEAVE THE MACHINE UNATTENDED DURING THIS PROCEDURE

1. Select Forward (F) spindle direction. The tachometer should display between 50 and 100 rpm.
2. Rotate the speed potentiometer cw for a speed of about 200 rpm. Run the spindle at that speed for about 1 minute, then progressively increase the speed to the max (about 1500 rpm), pausing for about 1 minute at each 200 rpm increment.
3. Repeat step (2) with the spindle reversed (R).
4. Set the belt for high speed, then repeat steps (2) and (3).

The machine should now be ready for normal operations.

 Copyright © 2020 Quality Machine Tools, LLC

Section 2 FEATURES & SPECIFICATIONS

MODEL PM-30MV Milling Machine

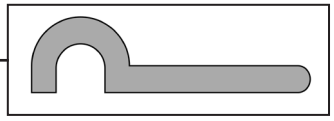
General information

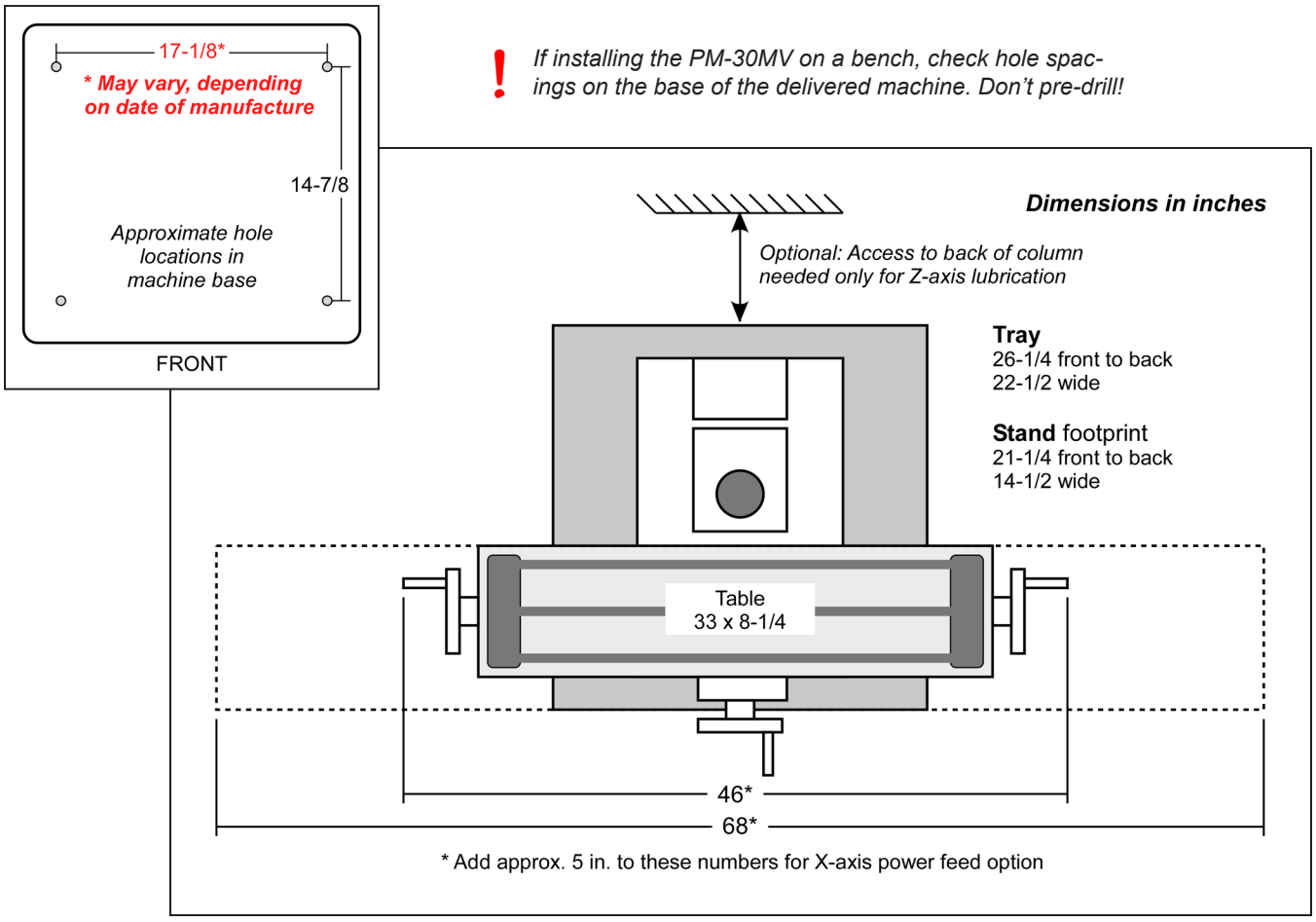
The PM-30MV is a robust “square column” mill with R8 spindle and continuously-variable spindle speed up to 3000 rpm. It is designed for day-in, day-out use in the model shop. With a weight of 530 lbs, excluding stand, it can handle far more than the typical small machine. For precise control of cutter depth there is a worm-driven quill downfeed with graduated dial and DRO, completely independent of headstock up/down position.

The reversible spindle runs in high-quality tapered-roller bearings enclosed in a heavyweight quill with coarse (“drilling”) and fine (“milling”) downfeed options.. It is powered by a 2 HP (1.5 kW) brushless dc motor. Spindle speed is continuously variable from 50 to 1500 rpm, low range, and 1400 to 3000 rpm, high range. This is a “gearless” design with two-step pulleys on motor and spindle coupled by a long-life ribbed belt. The headstock can be tilted 90° clockwise or counter-clockwise from the vertical.

Precision ground dovetailed ways for table and headstock ensure smooth, precise motion in all three axes: X = left/right motion of table, 23 in. Y = front/back motion of table, 7-5/8 in. Z = headstock up/down, 14-1/2 in. Note: Installation of a DRO with external scales may limit these numbers.

Special accessory supplied: Spindle nose C-wrench





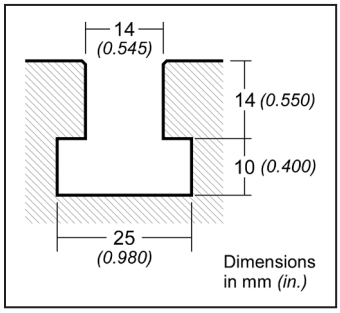
Working clearances – space requirements for full motion of the table

 Copyright © 2020 Quality Machine Tools, LLC

PM-30MV SPECIFICATIONS

Dimensions	Approximate net weight	Machine only 530 lb, stand 75 lb
	Overall size (on stand)	W 46-1/4 in. x D 31 x H max. 74-1/2 (headstock at normal working height, H = 67 in.)
	Stand footprint	W 14-1/2 in. x D 21-1/4
	Tray	W 22-1/2 in. x D 26-1/4
Electrical	Power requirement	220V, 60Hz, single phase, 15A minimum
	Spindle motor	Brushless dc, 1.5 kW (2 HP)
	X-axis power feed (option)	Gear motor: 110V, 60 Hz, single phase
Headstock	Vertical travel*	14-1/2 in.
	Left-right tilt	90 degrees clockwise/counter-clockwise
Spindle	Speed	Low range 50 to 1500 rpm, High range 1400 to 3000
	Internal taper	R8
	Quill travel	3 in.
	Spindle nose to table	18-1/4 in. max
	Spindle centerline to column	7-1/2 in. to pleated cover, 8-5/8 in. cover absent
	Drawbar	Standard 7/16-20 thread
Table	Size	33 x 8-1/4 in.
	Height over floor (on stand)	36 in. approx.
	Maximum load	300 lb, table centered (less if overhanging)
	Leadscrews	Acme, inch pitch, 10 TPI
	Left-right travel (X-axis)*	23 in.
	Front-back travel (Y-axis)*	7-5/8 in.
	T-slots (3)	14 mm wide, 63.5 mm (2-1/2 in.) centerline spacing

* DRO installation may limit these numbers



T-slot dimensions

 Copyright © 2020 Quality Machine Tools, LLC

Everyday precautions

- This machine is designed for milling and drilling operations by experienced users familiar with metal-working hazards.
- Untrained or unsupervised operators risk serious injury.
- Wear ANSI-approved full-face or eye protection at all times when using the machine (everyday eyeglasses are not reliable protection against flying particles).
- Wear proper apparel and non-slip footwear – be sure to prevent hair, clothing or jewelry from becoming entangled in moving parts. Gloves – including tight-fitting disposables – can be hazardous!
- Be sure the work area is properly lit.
- Never leave chuck keys, wrenches or other loose tools on the machine.
- Be sure the workpiece and machine ways are secure before commencing milling or drilling – hold-downs and/or vise fully tightened, X-Y-Z axes locked, cutting tool secured.
- Use moderation: **light** cuts, **low** spindle speeds and **slow** table motion give better, safer results than “hogging”.
- Don’t try to stop a moving spindle by hand – allow it to stop on its own.
- Disconnect 220V power from the mill before maintenance operations such as oiling or adjustments.
- Maintain the machine with care – check lubrication and adjustments daily before use.
- Clean the machine routinely – remove chips by brush or vacuum, not compressed air (which can force debris into the ways).

No list of precautions can cover everything.
You cannot be too careful!

 Copyright © 2020 Quality Machine Tools, LLC

Section 3 USING THE MILL

MOTOR CONTROLS

Before doing anything, check the installation instructions in Section 1

- Connect the mill to a 220Vac outlet.
- Press and release the green Power **ON** button to energize the control circuit; the tachometer should light. This is a self-latching circuit – when the **ON** button is released, a contactor in the electrical box maintains power until released by the red **OFF** button (also a momentary switch).
- The round orange E-stop button, right, is in series with the **OFF** button. Like the **OFF** button it de-energizes the control circuit completely, but it should be used only for its intended purpose – emergency disconnect. Once the E-stop button is pushed in, it stays in until twisted ***firmly clockwise*** to release.
- Also in series with the Power and E-stop buttons is a microswitch actuated by the acrylic Chip Guard in front of the spindle. The motor will not run if the chip guard is open.
- The spindle motor is controlled by a three position switch, Forward **F** - Stop **O** - Reverse **R**, and a continuously-variable speed control knob.

F = Forward (clockwise, looking down on workpiece, used for most milling and drilling
O = Stop
R = Reverse (counter clockwise, looking down)

Figure 3-1 **Motor controls**

SPINDLE SPEEDS

The PM-30MV is a belt-driven machine with two speed ranges, (**L**) 50-1500 rpm and (**H**)1400-3000 rpm.

To select a speed range, disconnect power, then remove the blue motor cover (4 screws). Loosen the socket head screws on each side of the motor, then swing the motor forward to free the belt, Figure 3-2. Make sure that the ribbed belt is properly engaged with the selected pair of grooved pulleys, then re-tighten. Before powering up, rotate the spindle by hand to check tracking and tightness of the belt. Do not over-tighten – aim for ± ¼" slack between the motor and spindle pulleys.

Excessive cutter noise, chatter, poor finish and tool wear are often the result of too high a feed rate, and/or too high a spindle speed. If unsure, go slow!

Figure 3-2 **Belt adjustment**

 Copyright © 2020 Quality Machine Tools, LLC

INSTALLING AND REMOVING TOOLING

The spindle and drawbar are designed for R-8 taper collets, drill chucks and other arbors with the standard 7/16”-20 internal thread.

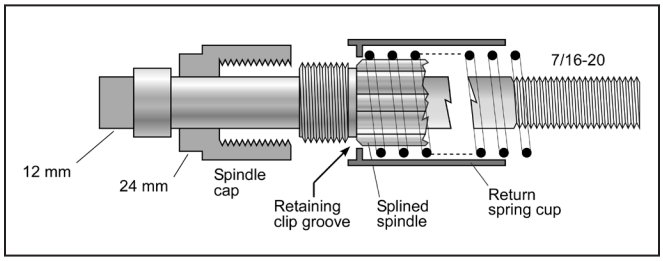


Figure 3-3 **Drawbar & spindle schematic**

Two tools are required to install or remove R8 tooling: a 12 mm wrench for the square drawbar nut, and the supplied C-wrench to engage the flats at the bottom end of the spindle.

Install tooling

Install the R-8 device, then hand-thread the drawbar into it until the shoulder on the drawbar bottoms on the spindle cap, Figure 3-4). Lock the spindle with the C-wrench while at the same fully tightening the drawbar with the 12 mm wrench. [Do ***NOT*** try to lock the spindle using the flats on the drawbar cap; this is screwed onto the spindle to secure a retaining clip above the return spring cup.]

R8 tooling is located in the spindle bore by a set screw. If it is difficult or impossible to insert the R8 device, chances are the set screw is in too far. Rotate the spindle by hand to expose the screw, Figure 3-5, then back it out a fraction of a turn using a 2.5 mm hex key.

Hand rotate the spindle again to check that the screw clears the inside surface of the quill.

Except for maintenance purposes, do not remove the spindle cap

Remove tooling

Protect the table, vise or workpiece under the spindle with rags or scrap wood. ***Why?*** Because they can easily be damaged by falling tools and drill chucks. The cutting tool itself can also be damaged in the same way.

Lock the spindle with the C-wrench, loosen the drawbar one half turn or less, just enough to unseat the taper, then tap the top of the drawbar with a brass or dead-blow hammer to free the device. Unscrew the drawbar with one hand while supporting the R-8 device with the other hand.

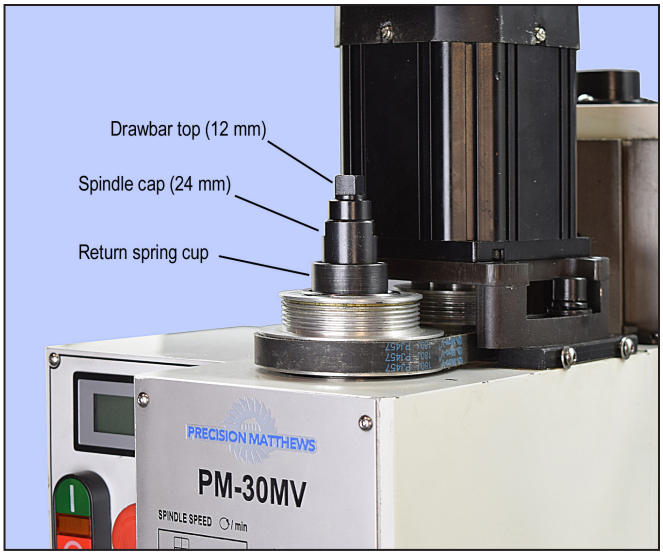


Figure 3-4 **Two-step belt drive**

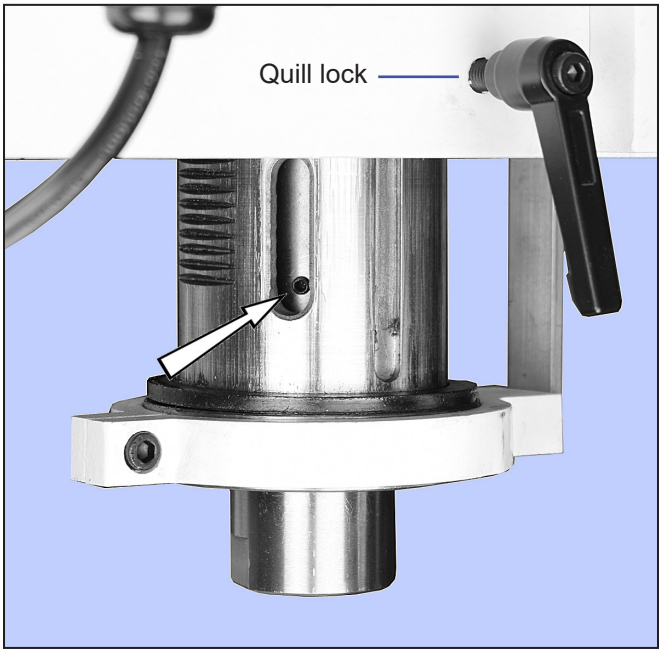


Figure 3-5 **Collet set screw**

MOVING THE TABLE

Conventionally, left-right movement of the table is said to be along the X-axis (also called “longitudinal travel” or “traversing”). Front-back movement is on the Y-axis, sometimes called “cross travel”.

Each axis has a leadscrew with handwheel and graduated dial with 0.001” divisions, 0.1” per revolution. If the mill is not equipped with digital readouts (DROs), the table can be accurately positioned by counting whole turns and divisions, keeping ***leadscrew backlash*** in mind. This means that table motion must always be in the same direction up to the point of reference, then on to the desired location, see “Positioning by Counting X-Y Divisions”, later in this section.

 Copyright © 2020 Quality Machine Tools, LLC

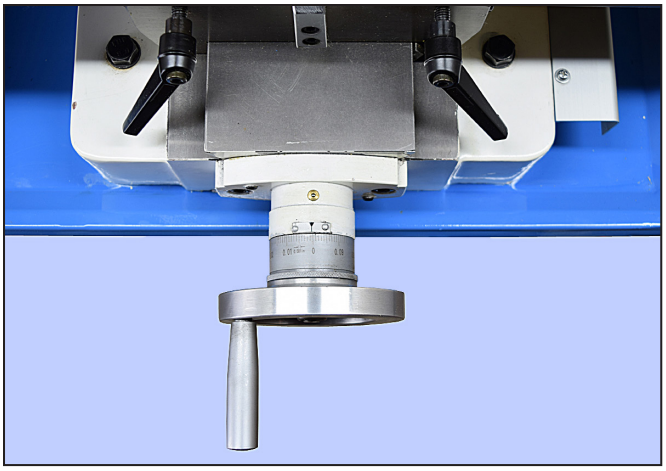


Figure 3-6 **X-axis locks** *(representative)*
These lock handles can block Y-axis motion. Keep them clear of the dovetails.

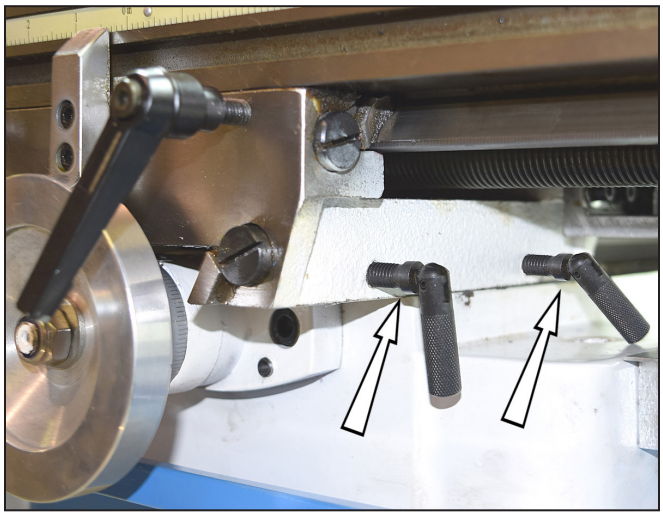


Figure 3-7 **Y-axis locks** *(representative)*
On some models these screws may have molded ratcheting handles like the X-axis locks

! In operations calling for precise depth control, such as milling, the quill should be fully retracted into the headstock and locked, Figure 3-8. The headstock should also be locked, Figure 3-9.

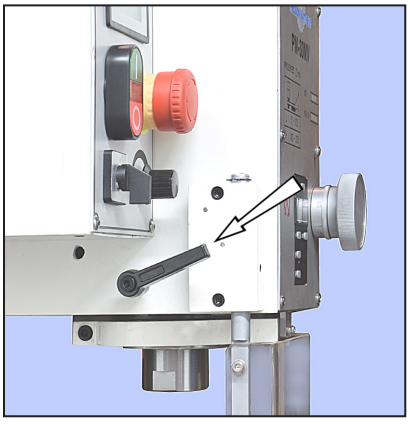


Figure 3-8 **Quill locking lever**

RAISING & LOWERING THE HEADSTOCK

The Z-axis crank, Figure 3-9 inset, is at the top right of the column. An air spring inside the column assists upward movement. If the mill has a 3-axis DRO the headstock position is displayed at all times. If not, the headstock can be positioned approximately by reference to an inch scale on the column. For more precise positioning the crank hub has a graduated dial with 0.001" divisions (be aware of backlash in the bevel gears controlling the Z-axis leadscrew, and also in the leadscrew nut).

When the headstock is at the desired height, lock it in place, especially for milling operations.

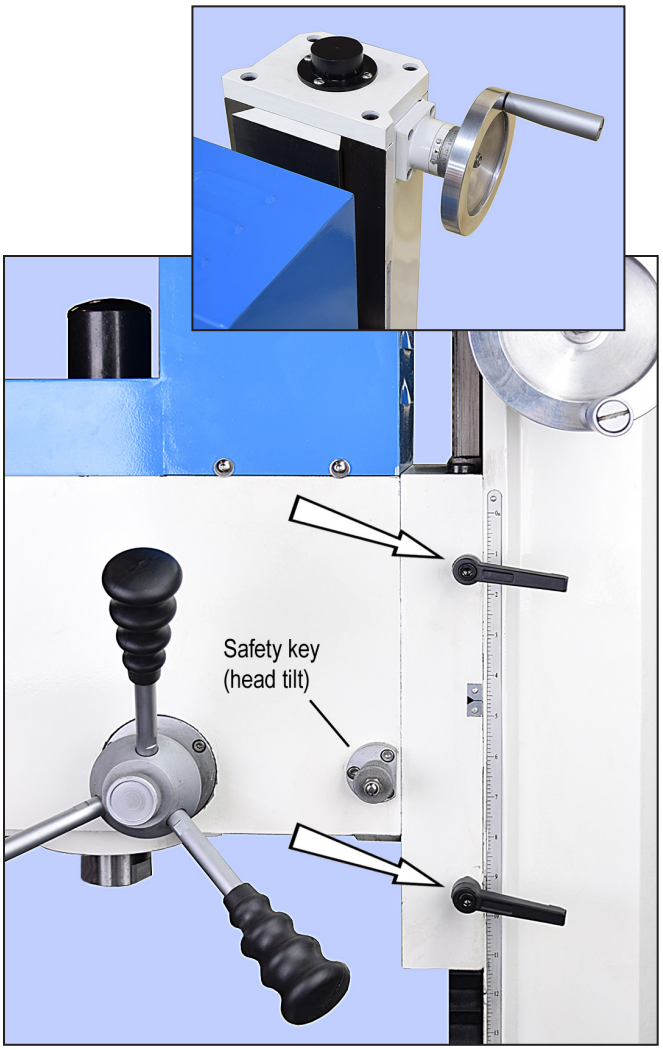


Figure 3-9 **Z-axis locks**

 Copyright © 2020 Quality Machine Tools, LLC

QUILL DOWNFEED

The quill is controlled in two different ways, ***coarse*** and ***fine***.

In the drilling mode, coarse feed, the mill operates like a standard drill press with a 3-lever hub; lever action lowers or raises the quill in the usual way by rack and pinion. Return action is assisted by a compression spring within the quill and spindle assembly.

For milling operations the lever hub is not rotated by lever action. Instead it is driven by a worm wheel rotated by the fine control knob. This allows the quill to be driven precisely to any desired position. The fine control knob, because it drives through a worm, cannot be back-driven by return-spring force on the quill (in other words, it stays where it's put). For milling operations the quill should be locked by the lever on the left of the headstock, Figure 3-8.

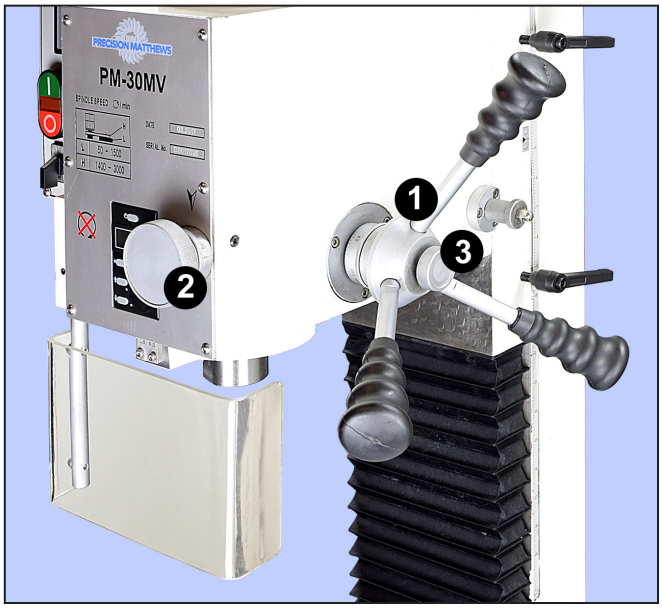


Figure 3-10 **Quill downfeed controls**
A pinion shaft connects the 3-spoke lever hub (1) to the quill pinion, which engages a rack on the back side of the quill. When the lever hub (1) is rotated forward — as in a drilling operation — the quill pinion drives the quill down. A worm gear sleeve on the pinion shaft is driven by the fine control knob (2). If the clamp knob (3) is loosened the fine control knob is free to rotate, doing nothing to the quill. Tightening knob (3) engages the fine feed by clamping the worm gear sleeve to the pinion shaft.

Coarse feed

For drilling operations, loosen knob (3); this allows the 3-spoke lever assembly to directly control the quill.

Fine feed

For milling operations calling for precise, repeatable control of tool depth, tighten knob (3) to engage the fine control knob (2). Tighten the Z-axis locks, Figure 3-9.

Rotate the fine control knob (2) to raise or lower the quill. Lower the quill by rotating the fine control knob clockwise, positioning it precisely either by counting divisions on the graduated collar inboard of hub (1), or by reference to the digital readout (DRO), Figure 3-1. Use the locking lever left of the headstock to hold the quill firmly in position.

The quill DRO – which has no backlash issues – offers a much less laborious way of setting tool height, but note that the quill is ***spring-loaded***. This calls for care when releasing the quill locking lever. If the fine control knob has been allowed to disengage (backed off counter clockwise), the quill may jump up by 0.01" or more. To avoid this, make sure the fine control has been turned ***clockwise*** to apply downward pressure on the quill before the locking lever is released.

If you are counting downfeed divisions be aware of backlash in the worm drive.

QUILL DRO

The quill DRO is in metric mode when switched on. Press the mm/in button to display inches.

Replace the battery by removing the small molded cover on the face of the DRO unit. Note that the white dots on cover and case must be aligned for removal and replacement. Check the type number and voltage of the installed battery. Replace with an equivalent silver oxide cell available from local retailers.

Switch off the DRO when not in use!

EDGE FINDING FOR ACCURATE POSITIONING

For edge-finding and table positioning, with or without DROs, be wary of the quill lock.

Why? On many vertical mills, including the heavier knee mills, locking the quill ***may*** offset the spindle by a few thousandths of an inch. If the edge of the workpiece has been "found" in the quill-locked condition, this can affect placement of holes drilled thereafter. To minimize the potential for positioning errors due to this, consider ***lowering the quill using the fine downfeed control when edge finding*** The fine downfeed is worm driven, so it stays where it's put without locking.

TABLE POSITIONING BY COUNTING DIVISIONS

In Figure 3-11 a hole is to be drilled exactly 0.25" on the Y-axis relative to the front edge of a workpiece in a vise, or otherwise clamped to the table.

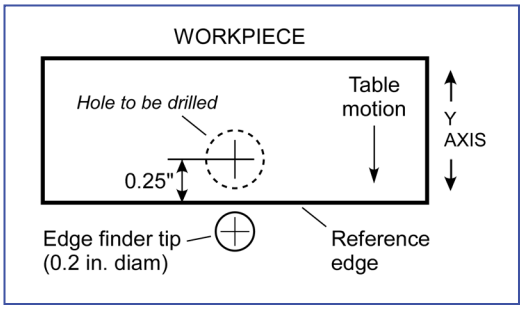


Figure 3-11 **Workpiece positioning example**

1. Install an edge-finder in collet or chuck (a tip diameter of 0.2" is assumed).
2. Lock the X-axis (optional).

 Copyright © 2020 Quality Machine Tools, LLC

3. If the reference edge is already to the back the spindle centerline, do nothing; if not, rotate the Y-axis handwheel clockwise to send the workpiece backwards (toward the column), placing the reference edge behind the edge finder.
4. Engage the fine downfeed, Figure 3-10.
5. With the spindle running, lower the quill as necessary using the fine downfeed control, then bring the table forward (counter-clockwise), stopping at the point where the edge-finder just makes contact (the tip jumps out of line). Stop the spindle.
6. While holding the Y-axis handwheel to prevent rotation, ***zero the Y dial***. Check the zero setting by turning the handwheel clockwise a full turn, then counter-clockwise to touch the edge finder for the second time.
7. Raise the quill, then rotate the handwheel one exact full turn counter-clockwise (0.1") to bring the reference edge to the spindle centerline. (Why? Because 0.1" is half the assumed diameter of the edge finder.)
8. Rotate the handwheel 2-1/2 turns counter-clockwise to bring 50 on the dial opposite the datum; the spindle is now 0.25" to the back of the reference edge, ready for hole drilling.

TAPPING OPERATIONS

When threading a drilled hole it is essential to align the threading tap properly in the bore. The mill is often used for this purpose, ideally with a dedicated (non-slip) tap holder or, for production work, an auto-reverse tapping attachment. A drill chuck can be used instead for sizes up to (say) M6 or 1/4", beyond which the chuck may not grip tightly enough to avoid slippage. Tapping can be done under power, or by hand turning the chuck.

For either method, it is essential to use a tapping fluid. Any cutting oil is better than none, but most users find Castrol's Moly Dee the most reliable for threading in steel.

If power tapping bear in mind that the spindle does not stop instantaneously, so be careful tapping blind holes. Be sure the quill locking lever is free, and start trial work with the lowest spindle speed.

TILTING THE HEADSTOCK

In routine operations the user relies on squareness of the spindle relative to both axes of the table. Front-to-back squareness is set at the factory, and is not adjustable by everyday methods. In the other plane the headstock can be set to any angle up to 90 degrees either side of the normal vertical position. Because re-establishing true vertical (tramming) on any mill is a time consuming process, most machinists look first for other ways of handling a project instead of tilting the head.

The headstock is secured by three nuts spaced 120 degrees apart, one underneath and one each side, Figure 3-12. A spring-loaded safety key, Figure 3-12, locks the headstock in ***approximate*** vertical and ± 90 degree positions; it must be pulled out for the headstock to be rotated. The headstock is top-heavy, and may swing suddenly to either side unless a helper is on hand to restrain it. Testing for moveability as you go, carefully loosen the nuts by degrees. Be especially careful if the head has not been moved before – the paint seal may let go without warning. (First-time tilting may also call for unusual effort on the wrench.)

Set the headstock to the desired angle by reference to the tilt scale on the headstock base casting, Figure 3-13, then re-tighten the nuts. The tilt scale is typically good to within ± 1/2°. A more accurate means of angle measurement will be needed if the project calls for greater precision.

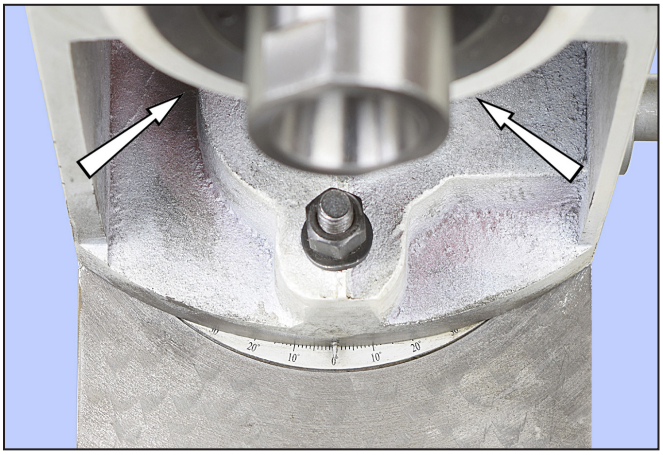


Figure 3-12 **Headstock nuts**

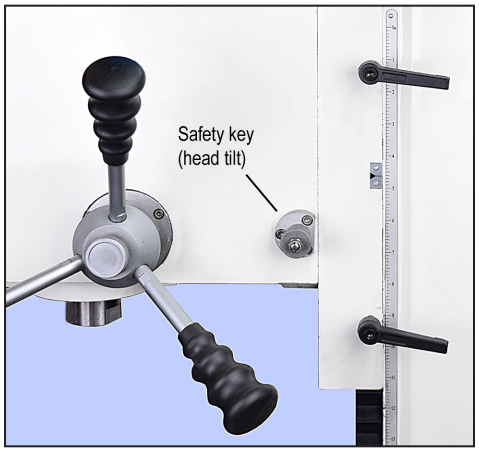


Figure 3-13 **Safety key**

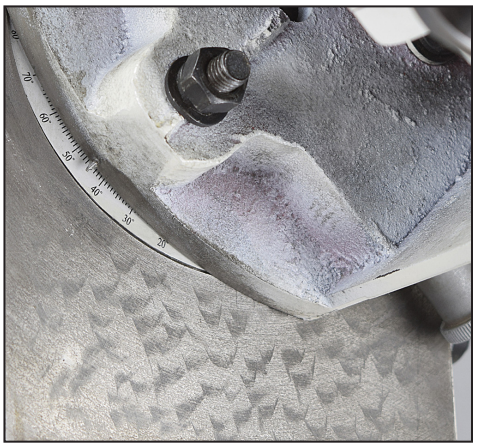


Figure 3-14 **Tilt scale: 45 degrees clockwise rotation**

 Copyright © 2020 Quality Machine Tools, LLC

Figure 3-15 **Headstock tilted 45 degrees counter-clockwise**

TRAMMING THE HEADSTOCK

As shipped, the mill is set to zero tilt, squared accurately enough for initial out of the box test drillings, etc. For more demanding project work thereafter, the spindle needs to be set at precisely 90 degrees relative to the table, in other words trammed. “Out of tram” may show up as an offset of a few thousandths between entry and exit of a deep hole, or as a scalloped effect when surfacing a workpiece with a large-radius fly cutter, greatly exaggerated in Figure 3-16.

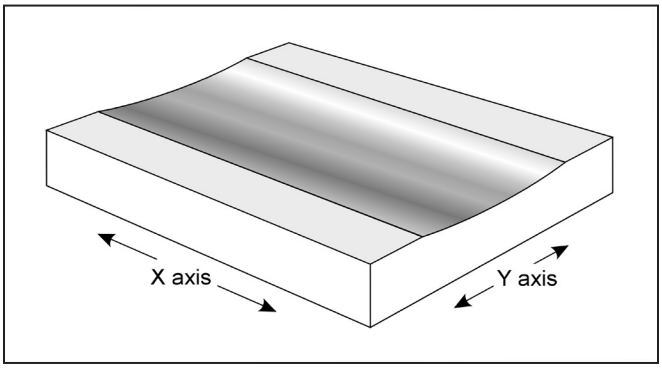


Figure 3-16 **Head tilt can affect surface flatness**

Tramming is done by fine-tuning the headstock tilt angle. Tram is typically checked by attaching a dial indicator to some form of “sweepable” holder installed in the spindle, the aim being to adjust tilt for the same reading on either side of the X axis. The longer the radius arm, the greater the sensitivity.

Figure 3-17 shows a typical shop-made holder; it has a threaded arbor allowing the choice of two radius arms, 6 and 10 inches measured from spindle centerline to indicator tip. A collet is used to hold the arbor, in this example 5/8” diameter. The dimensions are arbitrary, but note that the indicator must be firmly attached, and the arm rock-solid relative to the indicator spring force (which can be considerable on plunger-type indicators).

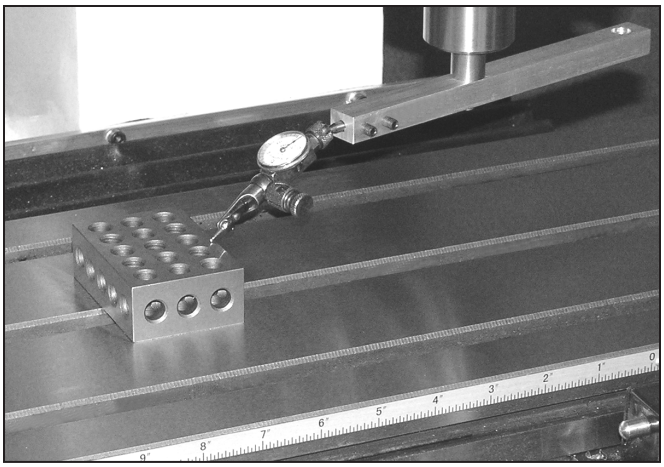


Figure 3-17 **Shop-made indicator holder**

A suggested procedure for establishing tram:

1. Disconnect power.
2. Install the dial indicator.
3. If the headstock has been tilted, reset it to the approximate zero degree position on the tilt scale, then tighten the three nuts enough to avoid unexpected headstock movement.
4. Remove the vise, if installed, and clean the table surface. If there are noticeable grooves or dings, flatten the surface with a diamond lap or fine-grit stone.
5. Set a 1-2-3 block (or other precision-ground block) on the table under the indicator probe.
6. Switch on the quill DRO.
7. Using the fine downfeed lower the spindle to give an indicator reading of about half-scale.
8. Note the dial indicator ***and*** DRO readings, then back off the fine downfeed at least a couple of turns to avoid collision when sweeping.
9. Reposition the 1-2-3 block to the opposite location on the table.
10. Swing the indicator holder to the new location, then lower the spindle – fine downfeed again – to give the same dial indicator reading as in step (8).

If the headstock is perfectly trammed – highly unlikely at the first shot – the DRO reading should be as in step (8). If not, loosen the nuts just enough to allow the headstock to be tapped a fraction of a degree in the direction called for, then re-tighten the nuts. The “tap” can be anything from a gentle slap of the hand to a rap with a dead-blow mallet.

Repeat steps (7) through (10) until satisfied with the tram, tightening the nuts as you go. This will likely call for several iterations. There is no “right” tram; the acceptable difference in side-to-side readings depends on project specs. As a starting point, aim for ± 0.001” with a sweep radius of 5 or 6 inches.

 Copyright © 2020 Quality Machine Tools, LLC

Tramming calls for patience! Expect to tighten and re-check at least three times (simply tightening the bolts can itself affect the tram).

A procedure similar to the above may be used to check tram in the Y-axis, front to back. The difference here is that there is that Y-axis tram is established in manufacture, and can be adjusted only by these shop methods:

1. Shimming between the dovetailed Z-axis saddle casting and the headstock itself. It is more likely that the headstock is nodding forward rather than leaning backward, so start with (say) a 2 mil shim in line with the underside (central) headstock nut. This is a temporary fix that will need to be checked if the headstock is tilted again.
2. Shimming between the underside of the column and the main base casting. This is a long-term fix. It is a two-person procedure, requiring an engine hoist or some other means of un-weighting the headstock (see Section 1, Installation). As an alternative to shims, which do not provide a uniform bearing surface, consider injecting a metal-filled two-part polymer.

INSTALLING & INDICATING A VISE

For routine milling operations the workpiece is held in a precision vise. For the PM-30MV a 4" vise is most suitable. "Indicating" means checking the alignment of the fixed (back) vise jaw relative to the axis of table motion.

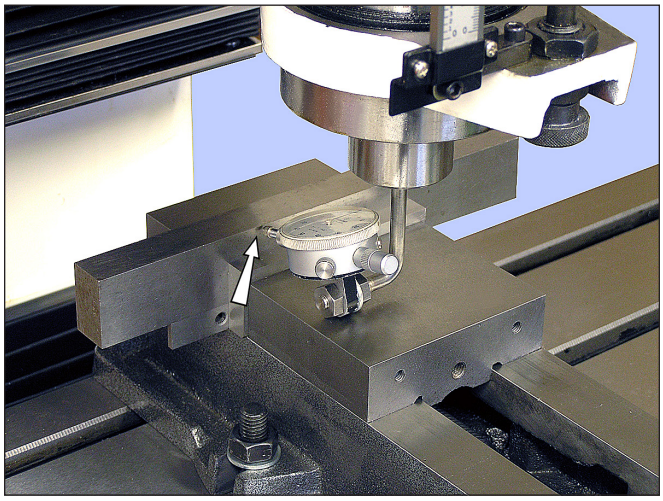


Figure 3-18 **Indicating the vise**
The tip of a standard dial indicator, arrowed, rides along the side face of a ground reference bar (or the front face of the back jaw).

Install the T-bolts and align the vise by eye. With one of the clamp nuts snug, but not tight, tighten the other one just short of fully-tight (but tight enough so the vise won't budge without a definite tap from a dead-blow mallet).

A typical setup for indicating is shown in Figure 3-18. Although there is no spindle lock, you need to ***make sure that the spindle does not rotate*** throughout the procedure. Set the indicator tip against the upper edge of a precision reference bar or, if not available, use the front face of the fixed jaw of the vise instead (check for dings, hone if necessary). Adjust the Y-axis to pre-load the indicator to mid range at the tightly-clamped side of the vise, then lock the Y-axis.

Note the indicator reading, then watch the indicator as you traverse the table slowly toward the loosely clamped side. ***(Also watch for any sign of spindle rotation.)*** Ideally, there should be no discrepancy between the indicator readings at the two ends — unlikely at the first attempt. Return the table to the starting point, then repeat the process, tapping the vise in as you go. Repeat the process as often as necessary for the desired accuracy, progressively tightening the "looser" nut. Now fully tighten both nuts, and re-check again (tightening a nut can itself introduce significant error). An established routine like this – tight to loose – can save a lot of time.

Most users aim for an end-to-end difference of not more than ± 0.001" over the width of the vise jaw.

VISE KEYS

Most precision vises come with key slots on the underside machined exactly parallel to the fixed jaw. Keys installed in the slots can be a great time saver, Figure 3-19. Properly installed they allow the vise to be removed and replaced routinely, accurately enough for general machining ***without the need for indicating every time***.

Most 4" vises have either 14 mm or 16 mm slots, calling for shop-made adapter keys as Figure 3-20. It is well worth the effort to make these precisely. Aim for a snug fit in both vise and table, but not so tight that it takes more than reasonable effort to lift the vise clear. Case hardening is recommended, with final fitting using a fine stone or diamond stone.

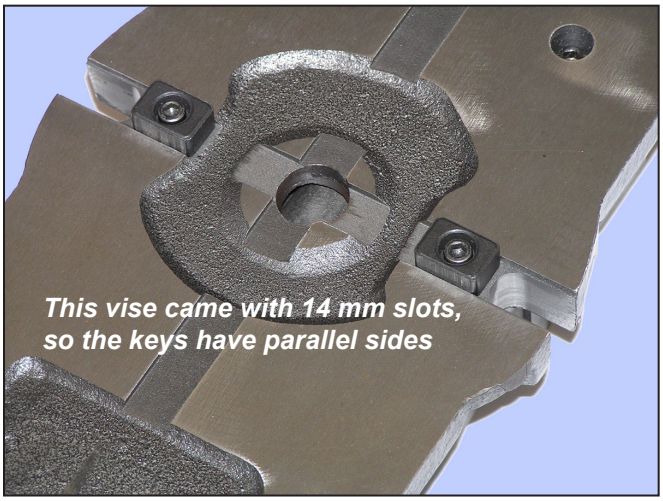


Figure 3-19 **Vise keys installed on X-axis**
On most vises the keys can also be installed on the long axis.

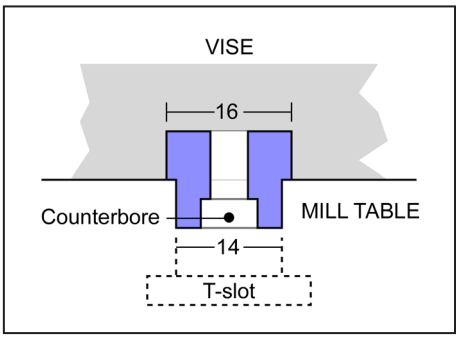


Figure 3-20 **Shop-made vise key**
Dimensions in millimeters

 Copyright © 2020 Quality Machine Tools, LLC

Section 4 MAINTENANCE

Unplug the 220V power cord before any maintenance operation!

Remove all machining debris and foreign objects before lubricating ANYTHING! If need be, any oil is better than no oil – but use the recommended lubricants when you can.

RECOMMENDED LUBRICANTS

Ball oilers/oil cups (X and Y leadscrews): ISO 68 oil, such as Mobil Vactra No. 2, or equivalent
X, Y and Z axis ways (dovetails): ISO 68 oil, Mobil Vactra No. 2, or equivalent
Visible gears such as quill rack and pinion, Z-axis bevel gears: light general purpose grease, NLGI No. 2, or equivalent
X and Y leadscrews: ISO 68 oil, Vactra No. 2, or equivalent
Z leadscrew: ISO 68 oil or NLGI No. 2 grease

GENERAL OILING

Assuming a clean environment – no abrasive particles or machining debris – lack of proper lubrication is the main cause of premature wear. Rotating parts are easy to lubricate, sliding parts are not. Gibs are tightened for the best compromise between rigidity and slideability, which means practically zero gap between the ways. Take time to understand exactly which are the bearing surfaces on the various dovetail surfaces; this is not obvious – some of the interfaces look like bearing surfaces, but are simply narrow gaps.

Every few hours of operation:

1. Apply the recommended way-oil with a dedicated short-bristle brush such as the type used for applying flux.
2. Use a similar brush to apply oil or grease to the leadscrews.
3. Apply oil to ball oilers/and or oil cups, see below.

Ball oilers

Use a pump-type oil can with tip large enough to more than span the oiler's spring-loaded steel ball. Oil pressure will displace the ball, allowing oil to flow, provided the oil can tip is firmly pressed onto the brass seating. Before oiling check that the ball is not stuck – press it lightly with a probe.

Quill rack and pinion

Lower and lock the quill. Using a stiff flux brush, clean the visible portions of the rack and pinion. Raise and lower the quill to expose the remainder of the working surfaces, locking and cleaning at each setting.

Spindle bearings

See Servicing Quill and Spindle, two pages on.

GIB ADJUSTMENT

Gibs on the X, Y and Z axes control the fit of the mating dovetailed surfaces. They are gently-tapered lengths of ground cast iron located by opposing screws at each end. Adjusting them is a trial and error process that takes time and patience. Aim for the best compromise of rigidity and reasonably free table movement. Too tight means accelerated wear on the ways and leadscrews. Too free means workpiece instability, inaccuracies and chatter.

Both screw heads must be tight against the gib ends. If you loosen one, tighten the other. Remove the way covers for access to the back of the Y gib and bottom of the Z gib.

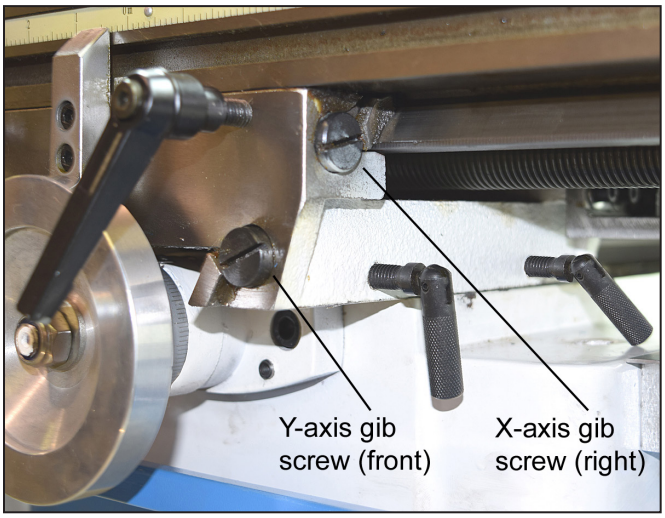


Figure 4-1 **Gib adjustment, X and Y axes** (representative)
The back adjustment screw for the Y axis gib is under the solid rubber way cover behind the table. The left adjustment screw for the X axis is in a similar location on the left side of the saddle casting.

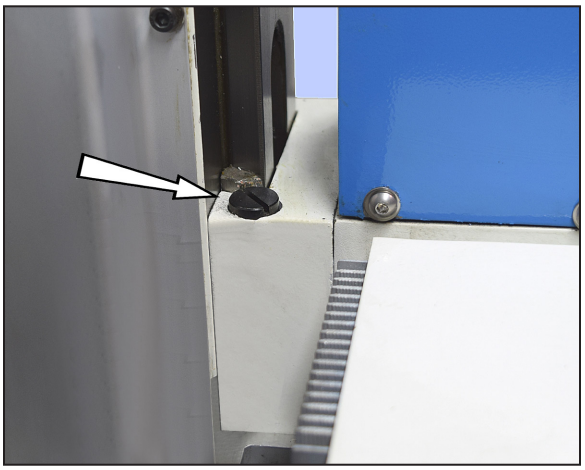


Figure 4-2 **Z-axis gib adjustment, upper screw**
The lower screw is under the pleated way cover.

 Copyright © 2020 Quality Machine Tools, LLC

LEADSCREW BACKLASH CORRECTION

When alternating between clockwise and counter clockwise rotation of the X or Y leadscrews, the handwheel moves freely a few degrees but the table stays put. This is backlash, a feature of all leadscrews other than the precision type found on CNC machines. The acceptable amount of lost motion depends on the user, but 0.005" is generally a good compromise. Smaller numbers are possible, but overdoing it can lead to premature wear of leadscrew and nut.

Excessive backlash can be corrected by compressing the leadscrew split nut. For the X-axis this is done by tightening the socket head screws on each side of the leadscrew, Figure 4-3. A long-handled 4 mm hex key is required, ideally one with an extra-thick shank to minimize flexing.

The Y-axis leadscrew nut has two similar adjusting screws, normally concealed by the solid rubber way cover at the back the table, Figure 4-4. A universal-jointed driver, or other type of flexible driver, is necessary to adjust the screws.

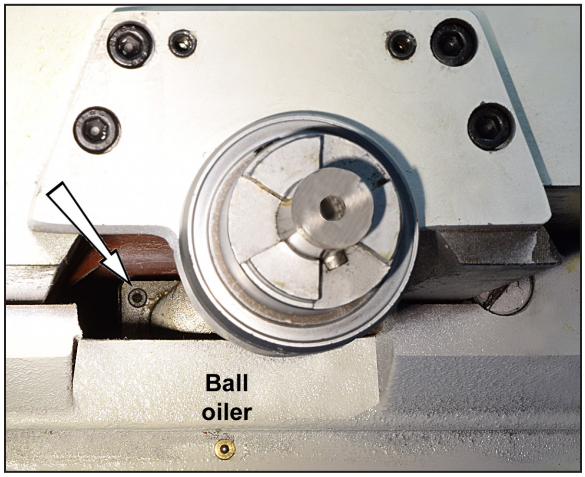


Figure 4-3 **X-axis backlash adjustment**
A second screw is located in a similar position on the other side of the leadscrew.

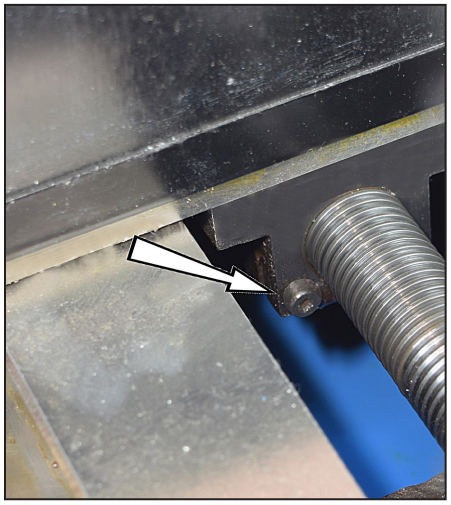
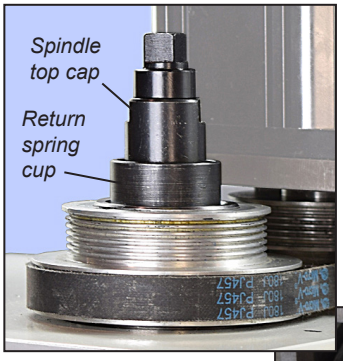


Figure 4-4 **Y-axis backlash adjustment**
A second screw is located in a similar position on the other side of the leadscrew.

DOWNFEED RETURN SPRING

The quill should automatically retract when the coarse downfeed levers are released following a drilling operation. If it does not, check the quill locking lever. The quill return spring, Figure 4-5, is contained in a spring cup which is locked to the spindle by a special retaining clip beneath the spindle cap. Spring force is not adjustable.



Spindle top assembly. The internally-threaded top cap screws onto the spindle, securing the retaining clip (below), which in turn holds the spring cup in place.

The retaining clip locates in grooves on each side of the spindle (spring cup removed for this photo)

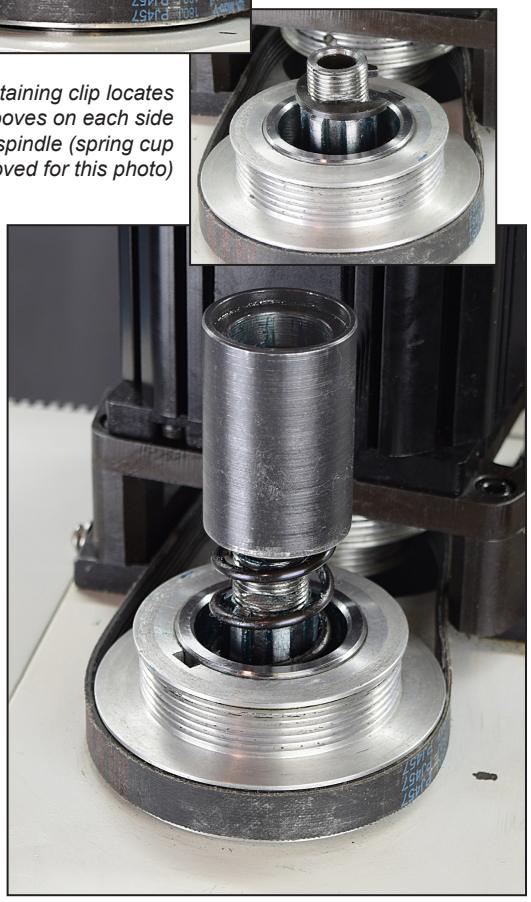


Figure 4-5 **Quill return spring**

SPINDLE BEARINGS

The spindle runs on grease-lubricated tapered roller bearings. These should be serviced every 500 hours of running time. Thoroughly clean each bearing assembly then repack with a grease such as Kluber Isoflex (auto shop wheel bearing grease can be used in low-load, low rpm operations).

Do not over-pack the roller bearings!

Bearing manufacturers recommend that the free volume between inner and outer should be no more than 30% filled with

 Copyright © 2020 Quality Machine Tools, LLC

grease. (If smothered with grease, bearings are subject to overheating.)

! *Especially during the first 10 hours of running time check that the spindle runs smoothly, without excessive heat build up (the spindle will run warm when used at high speeds over long periods, but should not be uncomfortably hot). Overheating can be due to excessive grease, see above, or an over-tight spindle installation. Call Precision Matthews for guidance.*

SERVICING QUILL & SPINDLE

In the normal use the quill assembly needs only oiling on its outer sliding surface. The spindle runs on pre-lubricated roller bearings and needs little attention, see Spindle Bearings, above. If the bearings need to be serviced or replaced, remove the quill/spindle assembly as follows:

1. Remove any installed R8 device from the spindle.
2. Place a scrap wood block on the table in line with the spindle, then lower the headstock to the point where the spindle nose rests on the block. This will prevent ***unexpected downward movement*** of the quill assembly.
3. Lock the lower end of the spindle with the supplied special C-wrench, then unscrew the spindle cap (24 mm flats) from the spindle.
4. Remove the drawbar.
5. Using a flat-blade screwdriver or other means, press down on the return spring cup while removing the retaining clip, Figure 4-5. ***Take care to prevent the cup from flying upward!***
6. Remove the return spring.
7. Remove the two button head screws securing the DRO scale to the quill assembly.
8. Lock the quill, Figure 3-8, then raise the headstock carefully. Slowly release the quill locking lever, while supporting the quill assembly from below. ***There is nothing to stop the unlocked quill falling out of the headstock!***

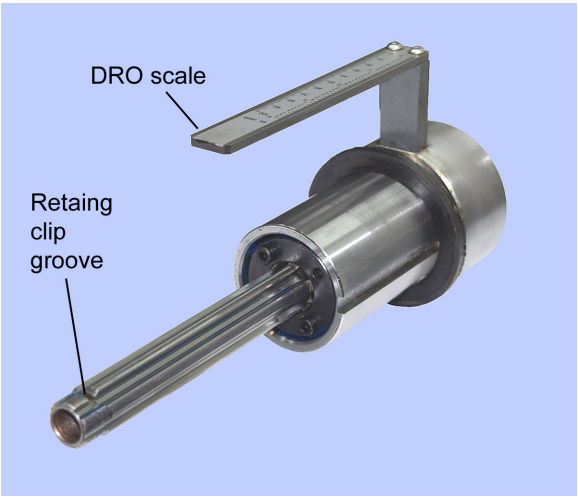


Figure 4-6 **Quill DRO scale and quill assembly** (representative)
For illustration only: for servicing operations the scale should be detached from the quill and should remain in the DRO case.

REMOVING THE HEADSTOCK

If you wish to remove the headstock be aware that it is secured to the base casting by a spring-loaded safety key, Figure 4-7 inset, in addition to the standard three M10 T-bolts and nuts, Figure 3-12. The safety key locates in a groove in the headstock base casting. Remove the entire safety key assembly before loosening the three T-bolts.

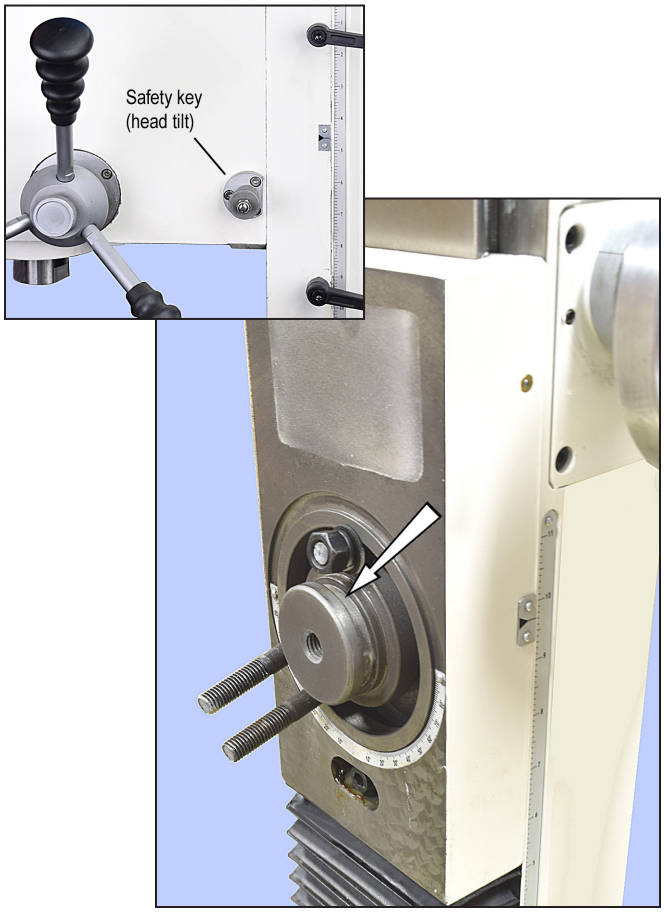


Figure 4-7 **Safety groove in headstock base casting**

 Copyright © 2020 Quality Machine Tools, LLC

INSTALLING THE TABLE (X-AXIS) POWER FEED

The power feed available from Precision Matthews is powered by the standard 110Vac 60 Hz supply. It comes with a complete manual and all mounting hardware. The outline description and photos on this page show the power feed unit installed on the PM-30MV.

Figure 4-8 **Power feed unit as shipped**
This is the underside of the unit. The pre-installed gray casting at top is referred to in the power unit manual as the "Big Adapter". The drive gear is arrowed.

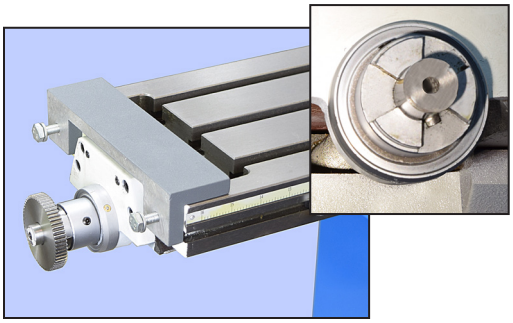


Figure 4-9 **Install the adapter bracket and leadscrew gear**
Remove the left-hand handwheel. Install the large gear on the leadscrew to engage the three "dog teeth", inset. Tighten the set screw in the gear. The bracket shown here is referred to in the power unit manual as "Small Adapter". It is secured by two M8 hex head screws (not shown) bearing on the left hand edge of the mill table. Do not ***over-tighten*** *the Small Adapter screws! Slots on the "Big Adapter", together with the two out-facing M8 screws, allow vertical adjustment to optimize engagement of the two gears.*

Figure 4-10 **Install the power feed unit**
Slide the unit down to engage the two pinions. Snug the hex head screws, but don't fully tighten.

! *Do not connect 115 Vac power until you have tried manual feeding (right hand handwheel) to check for proper engagement of the gears*

Gear engagement

"Proper engagement" is hard to specify. The separation that should exist between the gears can be gaged in several ways, one easy way being to insert a scrap of standard printer paper (usually about 0.004" thick) into the mesh, then crank the right hand handwheel. Lower the power feed unit to the point where the paper feeds through the gears with some resistance — but without binding. Once the paper is ejected the gears should be properly meshed.

Lubricate the gears with NLGI No. 2 grease!

Be sure the X-axis (table) locks are free.

Connect 110Vac power. Run the power feed unit ***slowly*** *in both directions. If gear noise is an issue, try raising or lowering the power feed unit — but don't expect a totally silent drive (these are straight-cut gears). Tighten the hex head screws, Figure 4-9.*

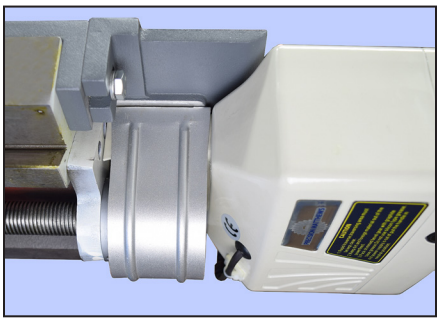


Figure 4-11 **Install the gear cover**

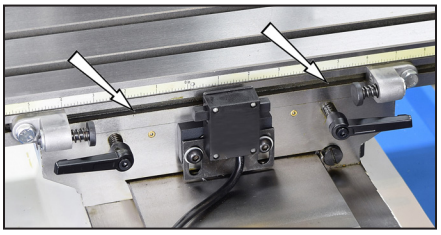


Figure 4-12 **Install the limit switch components**
To install the travel stop bumpers, left and right, it may be necessary to grind the T-nuts so they fit in the dovetail slot (arrowed) on the facing surface of the table. Install the limit switch in place of the table position marker post. Set the limit switch to align with the travel stop bumpers.

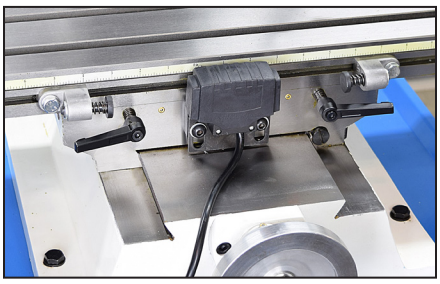
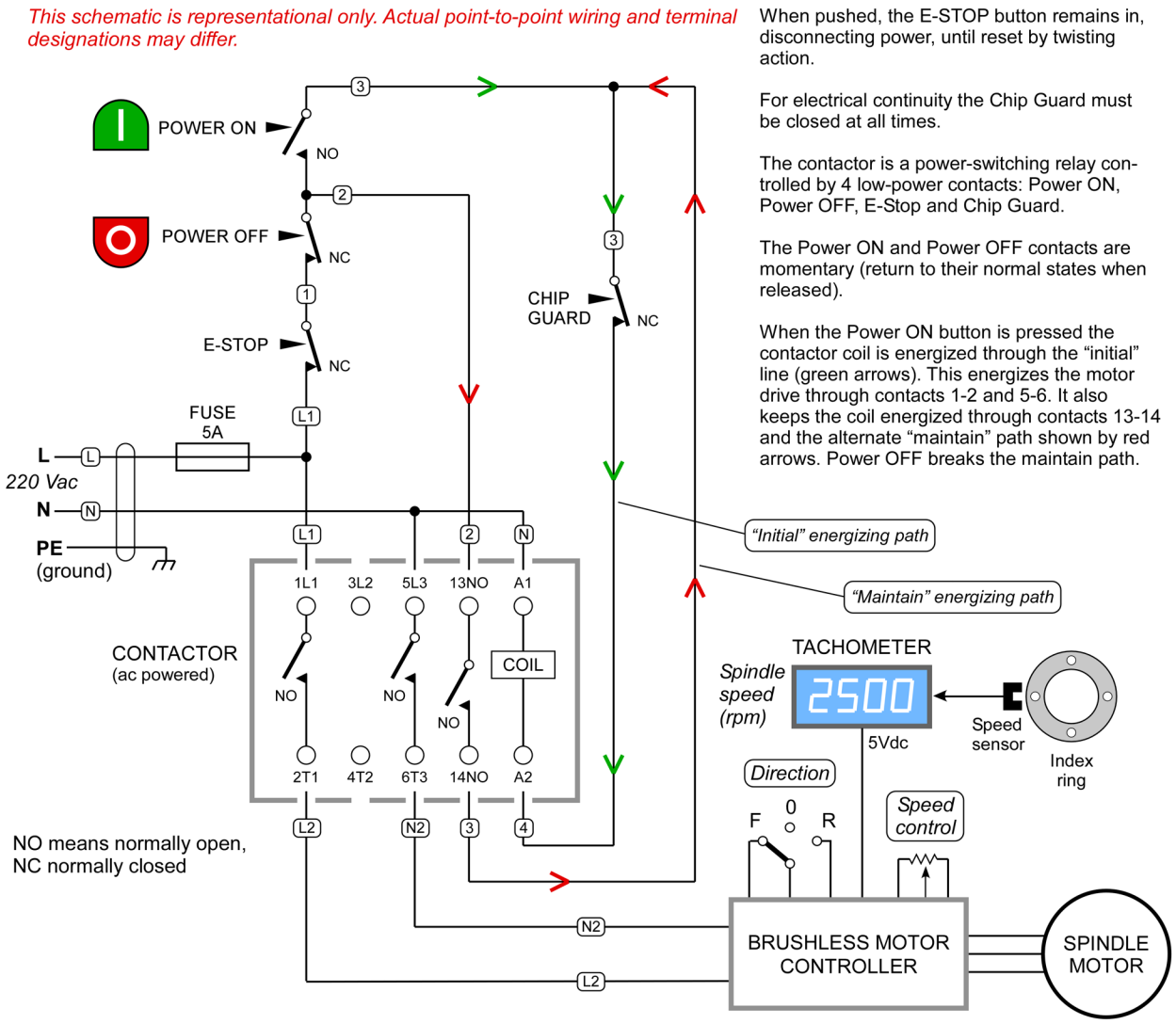


Figure 4-14 **Install the limit switch cover**
The cover has internal springs. Be sure they are in line with the limit switch plungers. When properly installed the cover should be freely movable from side to side with a small amount of spring resistance.

 Copyright © 2020 Quality Machine Tools, LLC

Section 5 PARTS

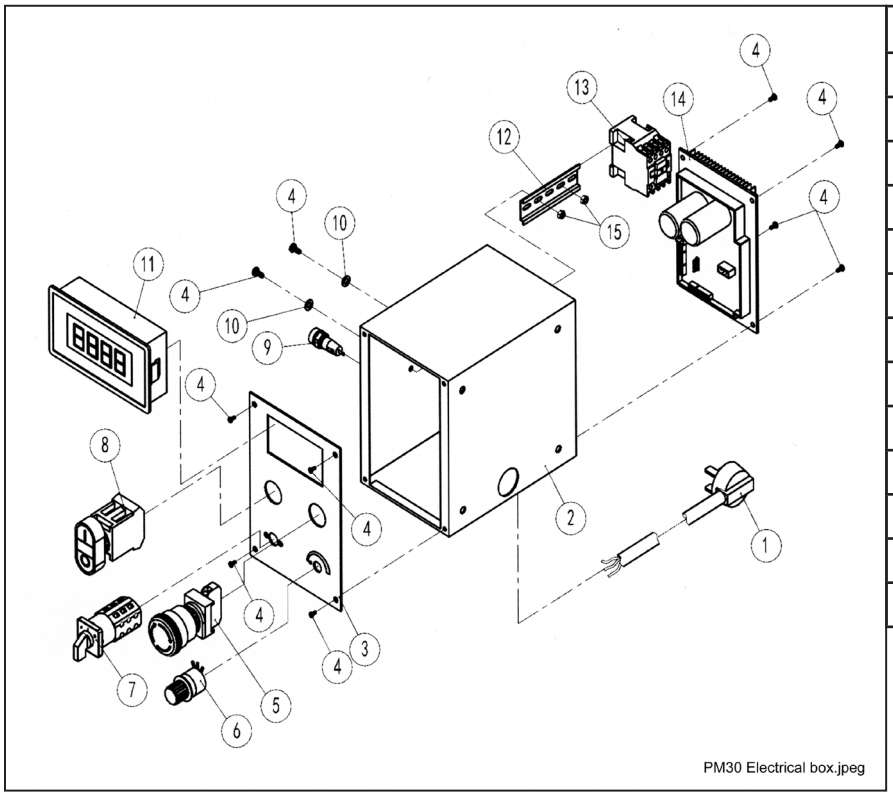


Model PM-30MV ELECTRICAL SCHEMATIC Fig 1

Copyright © 2020 Quality Machine Tools, LLC

PM-30MV ELECTRICAL BOX Fig 2

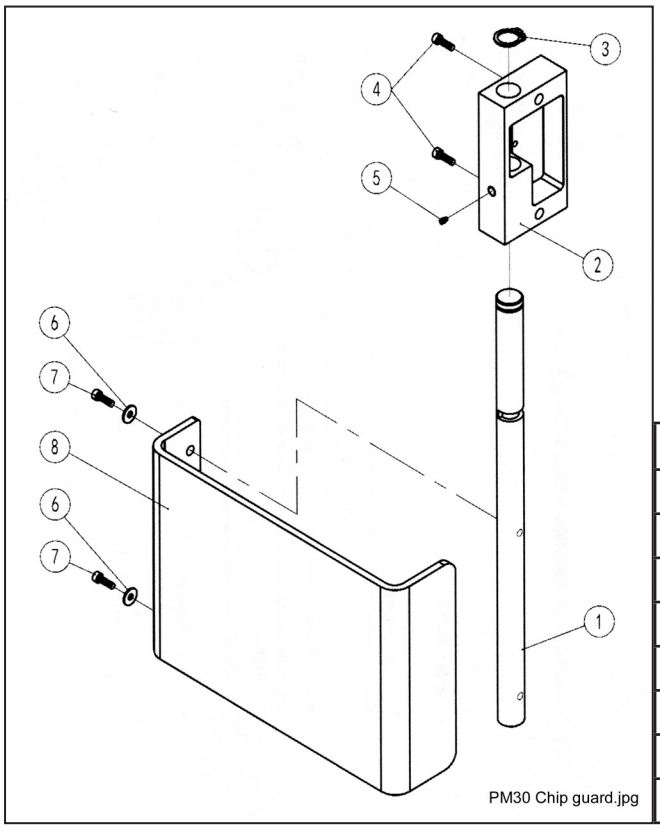
Dimensions in millimeters

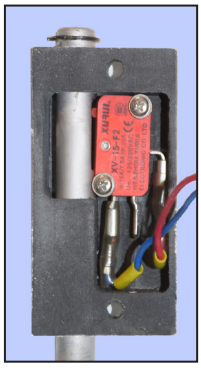


Ref	Description	Part
2	Box	Z5372
3	Front panel	Z5373
4	Screw M4×8	Z5374
6	Potentiometer	Z5375
7	Direction switch	Z5376
8	Power ON/OFF	Z5377
9	Fuse (5 A)	Z5378
10	Washer 4	Z5379
11	Tach display	Z5380
12	Contactor rail	Z5381
13	Contactor	Z7305
14	Control board	Z7306
15	Nut M4	Z7307

PM-30MV CHIP GUARD Fig 3

Dimensions in millimeters

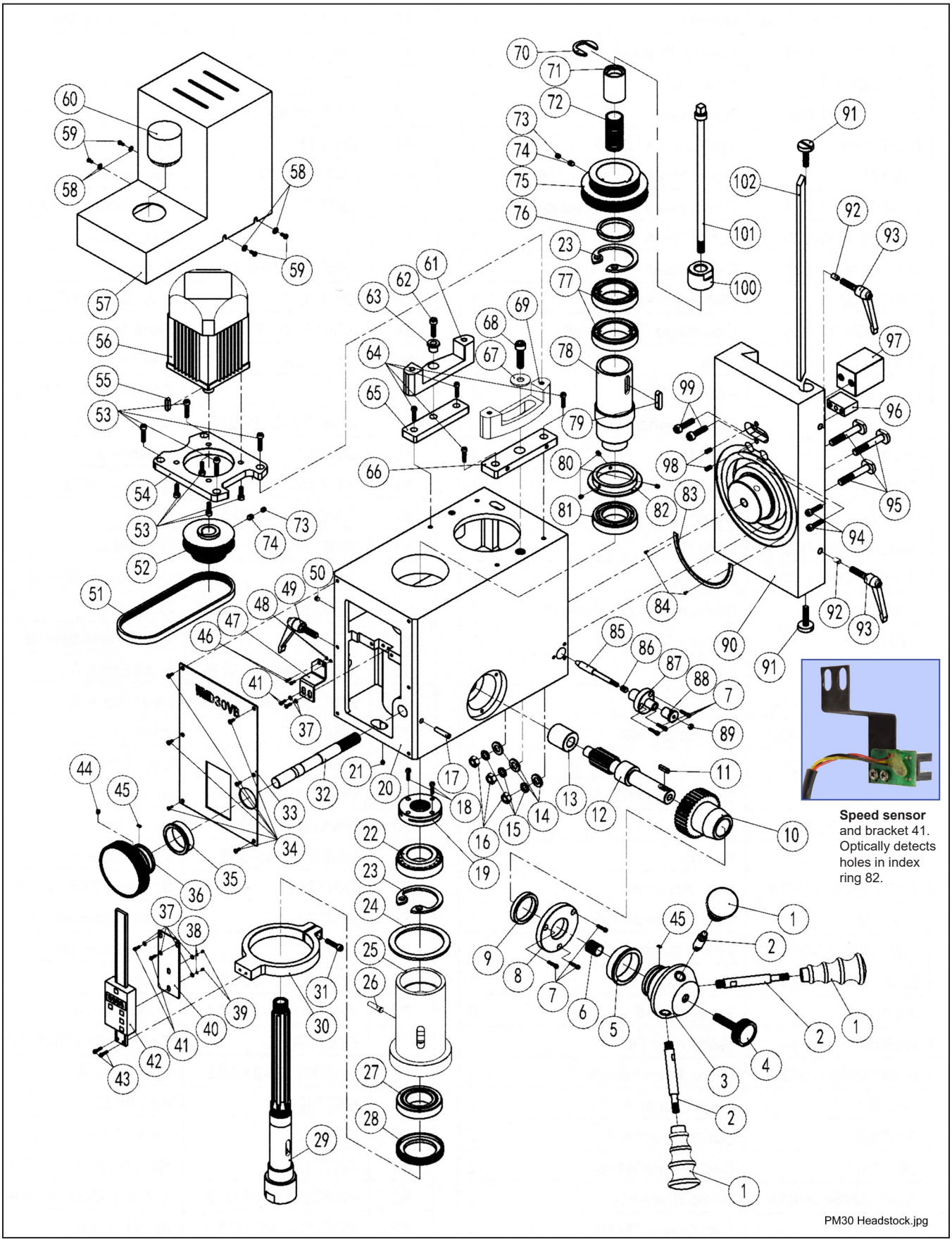




Ref	Description	Part
1	Rod	Z5382
2	Switch box	Z5383
3	Circlip 12	Z5384
4	Screw M5×16	Z5385
5	Screw M5×8	Z5386
6	Washer 4	Z5387
7	Screw M4×14	Z5388
8	Guard	Z5389

 Copyright © 2020 Quality Machine Tools, LLC

PM-30MV HEADSTOCK Fig 4



Speed sensor and bracket 41. Optically detects holes in index ring 82.

 Copyright © 2020 Quality Machine Tools, LLC

PM-30MV HEADSTOCK Fig 4

Dimensions in millimeters

Ref	Description	Part
1	Handle grip	Z5390
2	Handle	Z5391
3	Handle hub	Z5392
4	Clamp screw	Z5393
5	Downfeed dial	Z5394
6	Spring 1.2×12×25	Z5395
7	Screw M4×10	Z5396
8	Downfeed shaft flange	Z5397
9	Lock bush	Z5398
10	Worm gear	Z5399
11	Key 6×16	Z5400
12	Downfeed gear shaft	Z5401
13	Bushing	Z5402
14	Washer	Z5403
15	Lock washer 10	Z5404
16	Nut M10	Z5405
17	Pin 6×35	Z5406
18	Screw M5×12	Z5407
19	Lock nut	Z5408
20	Headstock	Z5409
21	Cone point scrw M6x12	Z5410
22	Bearing 32006/P5	Z5411
23	Retaining ring 72	Z5412
24	Rubber ring	Z5413
25	Quill	Z5414
26	Pin	Z5415
27	Bearing 32007/P5	Z5416
28	End cap	Z5417
29	Spindle	Z5418
30	Quill base clamp	Z5419
31	ScrewM6×20	Z5420
32	Worm shaft	Z5421
33	Faceplate	Z5422
34	Screw M4×8	Z5423
35	Fine-feed dial	Z5424

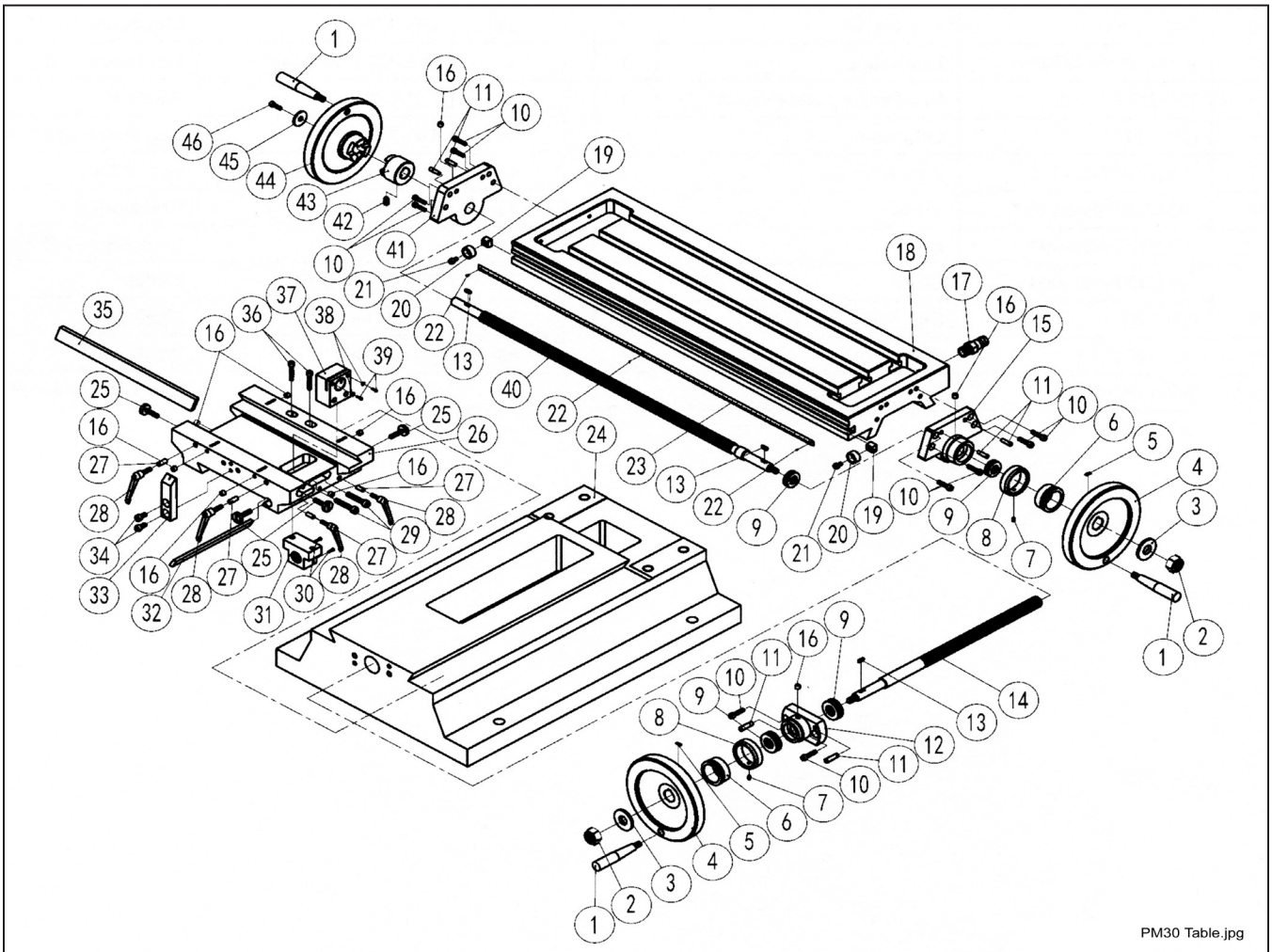
Ref	Description	Part
36	Fin-feed knob	Z5425
37	Flat washer 4	Z5426
38	Spring washer 4	Z5427
39	Screw M4×6	Z5428
40	DRO bracket	Z5429
41	Screw M4×8	Z5430
42	Quill DRO	Z5431
43	Screw M3×12	Z5432
44	Screw M5×10	Z5433
45	Leaf spring	Z5434
46	Screw M3×6	Z5435
47	Speed sensor bracket	Z5436
48	Screw M3	Z5437
49	Lock handle M8×25	Z5438
50	Screw M10x10	Z5439
51	Belt PJ457-6	Z5440
52	Pulley	Z5441
53	Screw M6×16 8	Z5442
54	Motor plate	Z5443
55	Key 6×20	Z5444
56	DC Brshless Mtr 1.5KW	Z5445
57	Motor cover	Z5446
58	Washer 5	Z5447
59	Screw M5×12	Z5448
60	Spindle cover	Z5449
61	Bracket A	Z5450
62	Screw M8×35	Z5451
63	Sleeve	Z5452
64	Screw M5×16	Z5453
65	Block A	Z5454
66	Block B	Z5455
67	Washer 12	Z5456
68	Screw M12×50	Z5457
69	Bracket B	Z5458
70	Retaining clip	Z5459

Ref	Description	Part
71	Return spring cup	Z5460
72	Spring 3.2×32.1×160	Z5461
73	Screw M6×8	Z5462
74	Screw M6×10	Z5463
75	Pulley	Z5464
76	Flange	Z5465
77	Bearing 61910-2RZ/P5	Z5466
78	Splined sleeve	Z5467
79	Key 8×32	Z5468
80	Screw M6×8	Z5469
81	Bearing 6207-2RZ/P5	Z5470
82	Speed index ring	Z5471
83	Angle scale	Z5472
84	Rivet 2×5	Z5473
85	Lock pin	Z5474
86	Spring 0.9×8×20	Z5475
87	Lock pin flange	Z5476
88	Lock pin plunger	Z5477
89	Nut M6	Z5478
90	Headstock base casting	Z5479
91	Gib screw	Z5480
92	Pin	Z5481
93	Lock handle M8×20	Z5482
94	Screw M8×30	Z5483
95	T-bolt M10×65	Z5484
96	Connector bracket	Z5485
97	Connector (to Z5570)	Z5486
98	Screw M6×16	Z5487
99	Screw M10×35	Z5488
100	Spindle cap	Z5489
101	Drawbar	Z5490
102	Gib	Z5491

Copyright © 2020 Quality Machine Tools, LLC

PM-30MV TABLE & BASE Fig 5

Dimensions in millimeters



Ref	Description	Part
1	Handle M10×80	Z5492
2	Lock Nut M10	Z5493
3	Washer 10	Z5494
4	Handwheel	Z5495
5	Leaf spring	Z5496
6	Dial	Z5497
7	Lock screw M5×6	Z5498
8	Bushing	Z5499
9	Bearing 51103	Z5500
10	Screw M8×25	Z5501
11	Taper pin 6×25	Z5502
12	Leadscrew bracket C	Z5503
13	Key 5×16	Z5504
14	Y-axis leadscrew	Z5505
15	Leadscrew bracket A	Z5506
16	Oil Cup 6	Z5507

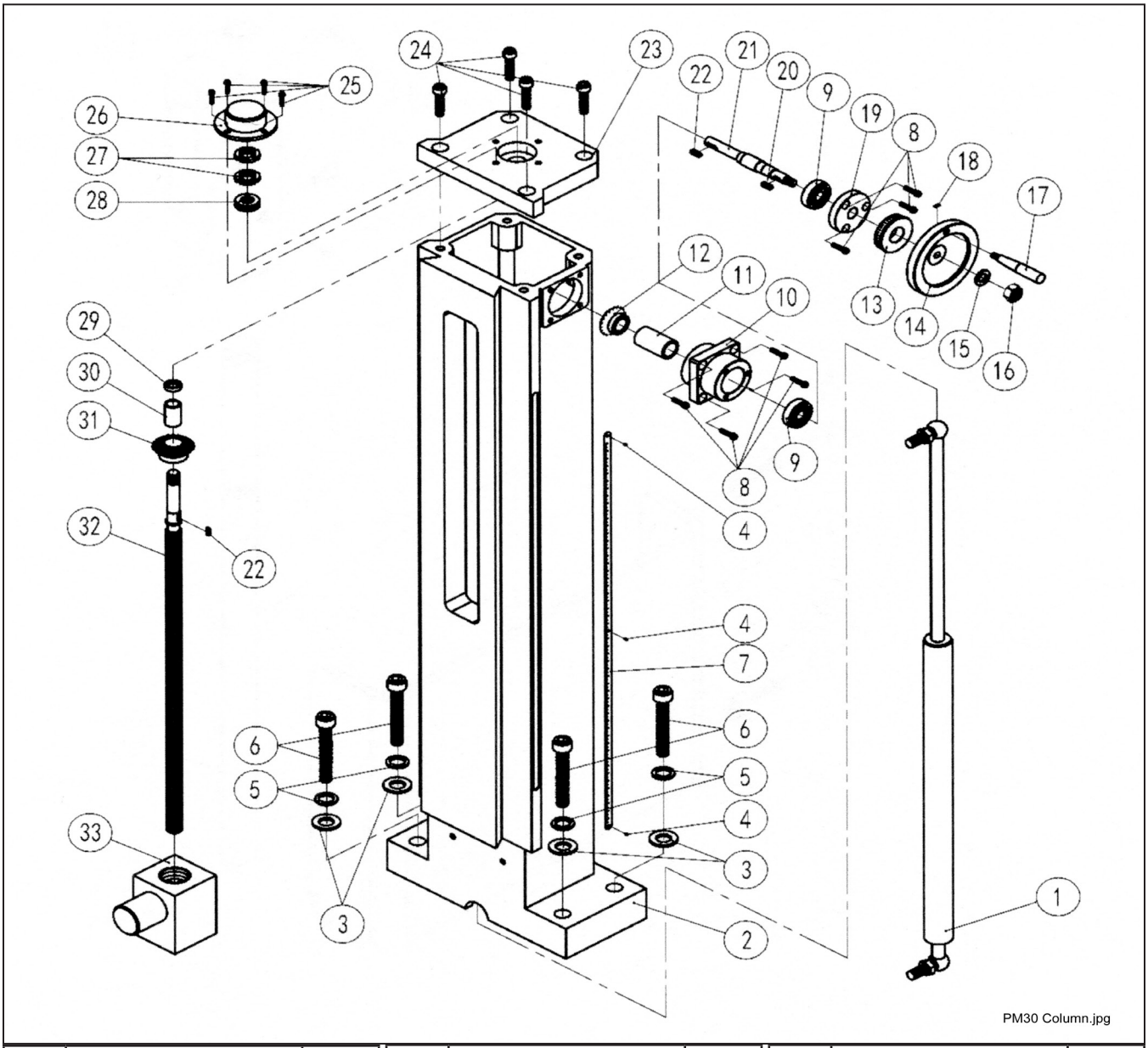
Ref	Description	Part
17	Pipe connector	Z5508
18	Table	Z5509
19	Dovetail nut	Z5510
20	Spacer	Z5511
21	Screw M6×10	Z5512
22	Rivet 2×5	Z5513
23	Scale	Z5514
24	Base	Z5515
25	Gib screw	Z5516
26	Saddle	Z5517
27	Pin 6×16	Z5518
28	Lock handle M8×25	Z5519
29	Screw M8×35	Z5520
30	Screw M4×12	Z5521
31	Y-axis leadscrew nut	Z5522

Ref	Description	Part
32	Gib	Z5523
33	Position marker	Z5524
34	Screw M6×12	Z5525
35	Gib	Z5526
36	Screw M×50	Z5527
37	X-axis leadscrew nut	Z5528
38	Washer 4	Z5529
39	Screw M4×14	Z5530
40	X-axis leadscrew	Z5531
41	Leadscrew bracket B	Z5532
42	Lock screw M5×10	Z5533
43	Dog clutch	Z5534
44	Handwheel	Z5535
45	Washer 6	Z5536
46	Screw M6×20	Z5537

Copyright © 2020 Quality Machine Tools, LLC

PM-30MV COLUMN Fig 6

Dimensions in millimeters



Ref	Description	Part	Ref	Description	Part	Ref	Description	Part
1	Air spring	Z5538	12	Bevel gear	Z5549	23	Cover plate	Z5560
2	Column	Z5539	13	Dial	Z5550	24	Screw M8×25	Z5561
3	Washer 14×5	Z5540	14	Handwheel	Z5551	25	Screw M5×8	Z5562
4	Rivet 2	Z5541	15	Washer 8	Z5552	26	Cap	Z5563
5	Spring washer 14	Z5542	16	Nut M8	Z5553	27	Nut M16×1.5	Z5564
6	Screw M14×80	Z5543	17	Handle M10×80	Z5554	28	Bearing 51203	Z5565
7	Scale	Z5544	18	Leaf spring	Z5555	29	Copper sleeve	Z5566
8	Screw M5×12	Z5545	19	Flange	Z5556	30	Bushing	Z5567
9	Bearing 6001-2Z	Z5546	20	Key 4×12	Z5557	31	Bevel gear	Z5568
10	Bearing flange	Z5547	21	Shaft	Z5558	32	Z-axis leadscrew	Z5569
11	Bushing	Z5548	22	Key 4×16	Z5559	33	Leadscrew nut	Z5570

Copyright © 2020 Quality Machine Tools, LLC